

Feb 5th, 11:30 AM - 12:45 PM

Presentation Panel on Management and Storage

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Duke University

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2.
<https://doi.org/10.25820/jyey-as56>

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Helping determine and serve the needs of the 3D community

Doug M. Boyer / MorphoSource Director (Duke)

Julie M. Winchester / Product Manager & Developer (Duke)

Tim McGeary / Associate University Librarian of IT (Duke)

Tim Ryan / Director of CQI (Penn State)



PennState



Data repositories

- Fundamental metadata
 - Data packet
 - Individual file
 - Flexible



Open Science Framework

MorphoSource

- Fundamental metadata
 - imaging event
 - Includes one or more files
 - Associated specimen record



Virtual Museum



Virtual Museum



MORPHO SOURCE

- **Emulates a museum collection**
- **Goals**
 - Support research (data access)
 - Support data publishing & archiving
 - Encourage sharing of “research quality data”
- **Bonus**
 - Useful for outreach and education



Example project page

Project: AMNH Mammal Collection

BACK

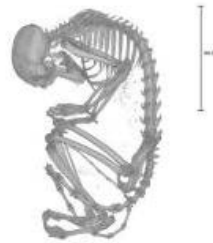
55 Project Specimens

Group by: [Specimen Number](#) | [Genus](#) | [Species](#)

NEW SPECIMEN



[AMNH-M-174360](#), *Microcebus rufus*
iDigBio



[AMNH-M-183285](#), *Callimico goeldii*
iDigBio



[AMNH-M-183291](#), *Callimico goeldii*
iDigBio



[AMNH-M-185280](#), *Callimico goeldii*
iDigBio



[AMNH-M-185640](#), *Daubentonia madagascariensis*
iDigBio



[AMNH-M-185643](#), *Daubentonia madagascariensis*
iDigBio



[AMNH-M-187861](#), *Cynocephalus volans*
iDigBio



[AMNH-M-188009](#), *Alouatta seniculus*

MORPHO SOURCE

- **Research Quality (?)**
- **Mostly about metadata...**
 - Connection to vouchered specimens
 - Detailed description of resource creation method
 - Stored in standard (open access) formats
 - Explicit history of modifications and relationships to other resources



MORPHO SOURCE

at a glance

- Founded 2013
- Place for 3D data on vouchered specimens



MORPHO SOURCE at a glance

- Founded 2013
- Place for 3D data on vouchered specimens
- Underlying digital repository system
- Staffed and funded





team

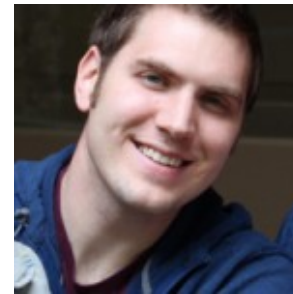
Directors

Developers



MORPHO SOURCE team

Other support (Duke Digital Repository)





governance

- Advisory board

| Person | Institution/Position | Expertise and/or role |
|----------------|-----------------------------------|----------------------------------------------------------------|
| S. Anton | NYU, Prof. of Anthropology | Hominin fossils/President of the AAPA |
| D. Blackburn | FLMNH, Curator of Herpetology | Amphibians/vast scanning and bioinformatics experience |
| G. Nelson | FSU, Inst. for Digital Info. | Botany/Principle digitization coordinator for iDigBio |
| J. Maisano | UT Austin UTCT/Resrch Assoc. | CT scanning modalities, metadata, and data storage |
| J. Richtsmeier | PSU, Prof. Anthropology | Model animals & molecular developmental mechanisms |
| L. Witmer | OSU, Prof. of Biomedical Sci. | Vertebrate anatomy/evolutionary analysis of 3D digital data |
| R. Snyder | NMNH, Digital Media Specialist | Database design, museum DB standards for interoperability |
| C. Ross | U. Chicago, Prof. Organismal Bio. | Biomechanical analysis of cranial morphology |
| C. Grant | FLMNH, PhD in Educ. Science | Expertise helping teachers use natural history data in lessons |

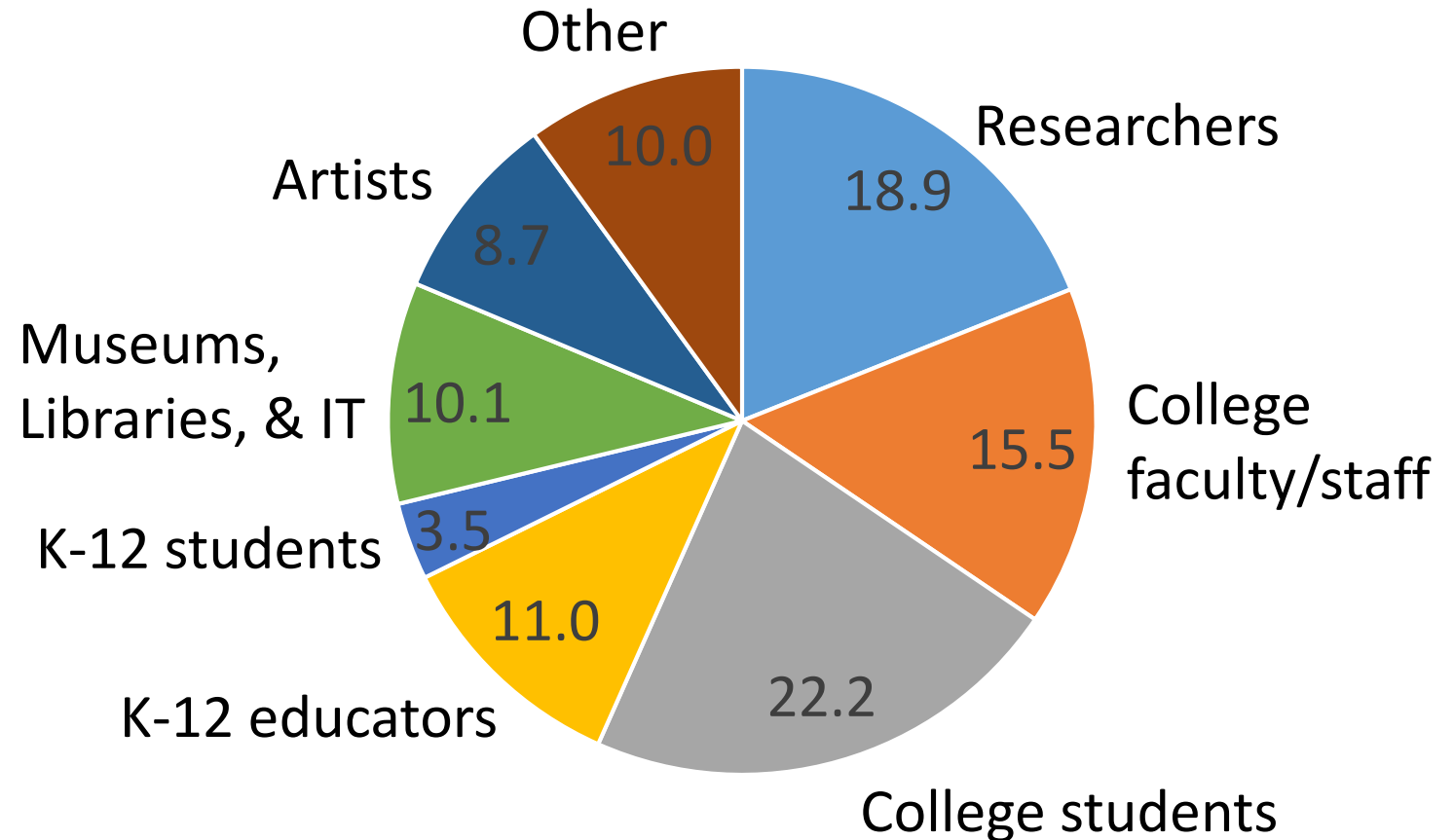


at a glance

Our community

- 5,400 users
- 84 countries
- 221 institutions
- 92 imaging facilities

Users



MORPHO SOURCE

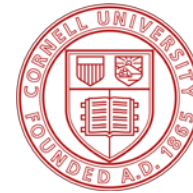
at a glance

Our Community

- “oVert”
 - 16 institutions
 - Scan 85% of vertebrate genera
 - Add 20,000 scans



UC San Diego



TEXAS A&M
UNIVERSITY



THE ACADEMY
OF NATURAL SCIENCES
of DREXEL UNIVERSITY





at a glance

Our Community

- Bio/Geoinformatics



Biodiversity
Information
Standards
T D W G



PBDB



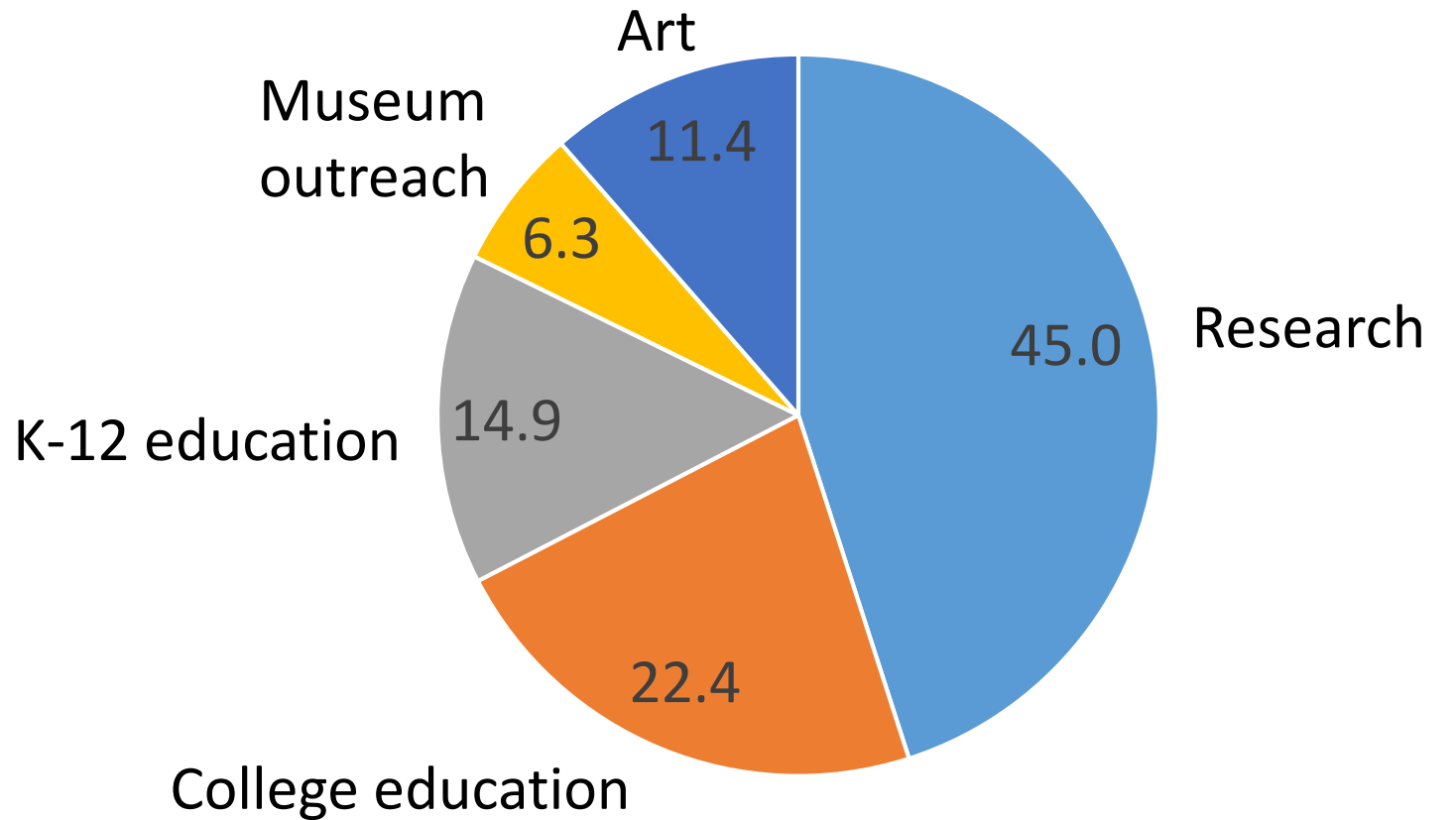


at a glance

Access rates

- 80,000 downloads
- 920,000 views
- *16,000 downloads intended for 3D printing*

Use



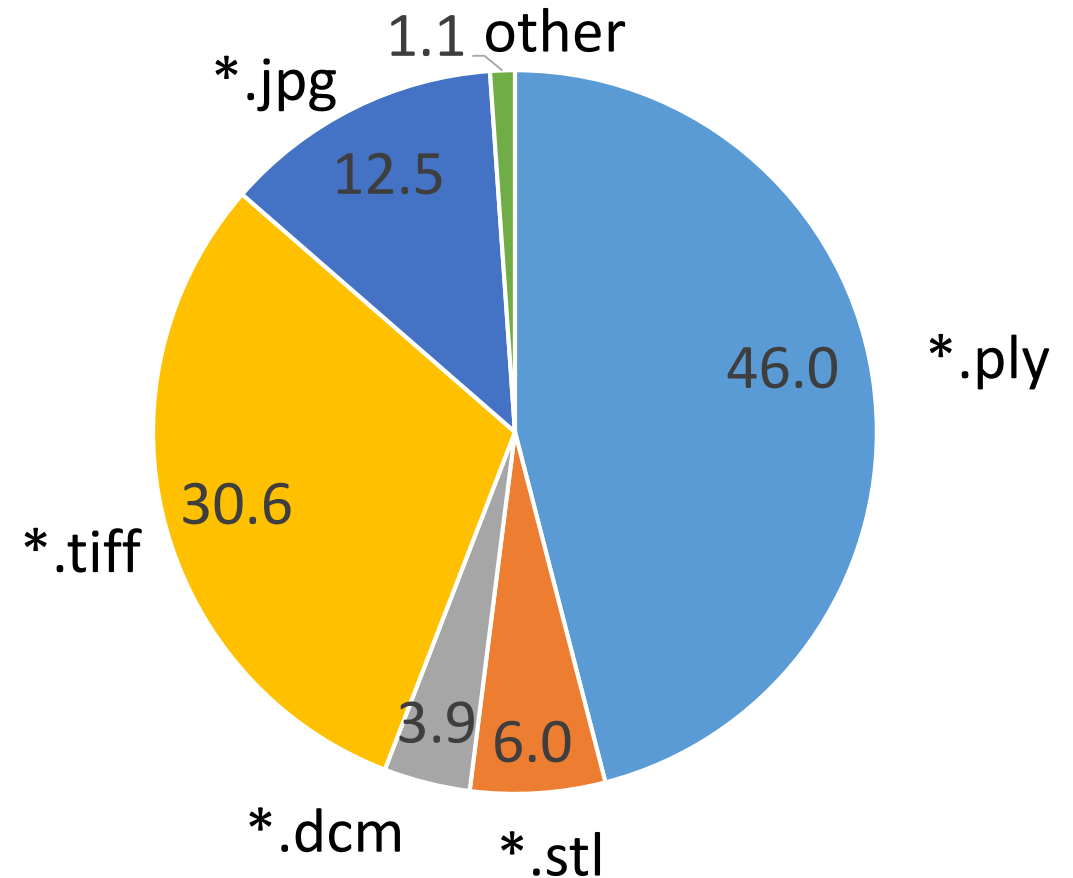


at a glance

Holdings

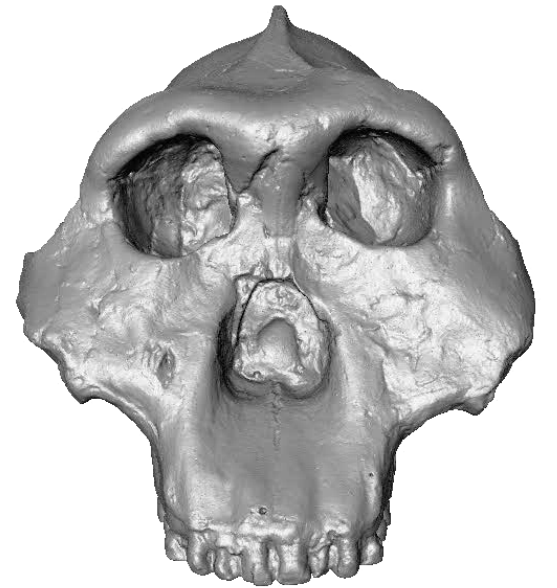
- 37,000 files (15 Tb)
- 10,000 specimens
- 3,800 species

Formats



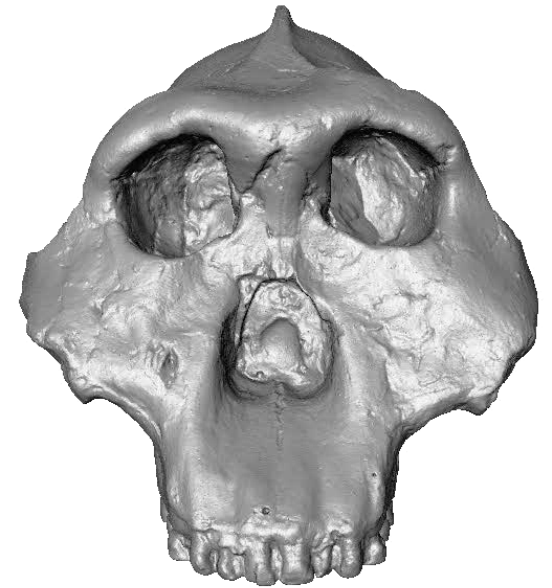
Outline

- Critical data
- Digital provenance
- Managing long term storage
- Challenges for repositories



Outline

- **Critical data**
- Digital provenance
- Managing long term storage
- Challenges for repositories





Critical data

It depends...

- Imaging modality (CT, Photogrammetry, laser, etc.)
- Original use (in science or education, etc.)
- Risk involved to specimen / rarity of scanning opportunity



Critical data

MorphoSource supports...

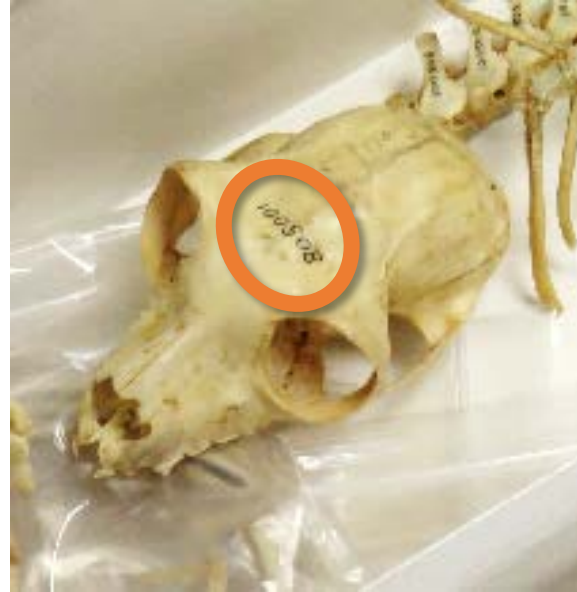
- Open formats
- Image stacks, and recommends against archiving CT projection data
- Mesh files
- Some other stuff
- More formats can always be added



MorphoSource requires...

- Catalogue number for scan
- Scanner facility + make/model used to create image

Critical data



Community preference (formats)

Surface mesh

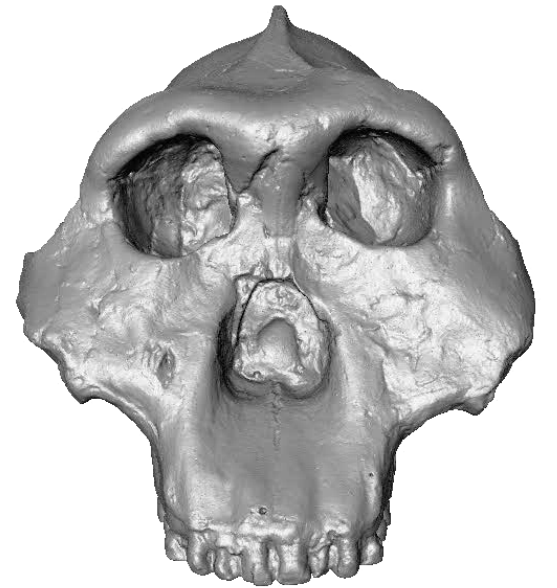
| FORMAT | PREFERRED |
|---------------|-----------|
| NO PREFERENCE | 25% |
| .STL | 35% |
| .OBJ | 16% |
| .PLY | 10% |

Volume

| FORMAT | PREFERRED |
|---------------|-----------|
| NO PREFERENCE | 63% |
| .DCM | 15% |
| .TIFF | 14% |
| .JPG | 6% |

Outline

- Critical data
- **Digital provenance**
- Managing long term storage
- Challenges for repositories



- 

| Specimen | Element | Side | MoSo media | Doi | File |
|----------|------------|-------|------------|-----------------------|----------------|
| IPS-7712 | Astragalus | Left | M6345-6065 | doi:10.17602/M2/M6065 | Ply, me |
| IPS-7713 | Astragalus | Right | M6346-6066 | doi:10.17602/M2/M6066 | Ply, me |
| IPS-7750 | Astragalus | Left | M6347-6067 | doi:10.17602/M2/M6067 | Ply, mes |
| IPS-7796 | Astragalus | Right | M6348-6068 | doi:10.17602/M2/M6068 | Ply, mesh |
| IPS-7743 | Calcaneus | Left | M6349-6069 | doi:10.17602/M2/M6069 | Ply, mesh |
| IPS-7748 | Calcaneus | Right | M6350-6070 | doi:10.17602/M2/M6070 | Ply, mesh f |
| IPS-7749 | Calcaneus | Right | M6351-6071 | doi:10.17602/M2/M6071 | Ply, mesh fi |
| IPS-7751 | Calcaneus | Right | M6352-6072 | doi:10.17602/M2/M6072 | Ply, mesh file |
| IPS-7798 | Calcaneus | Left | M6353-6073 | doi:10.17602/M2/M6073 | Ply, mesh fil |
| IPS-7799 | Calcaneus | Right | M6354-6074 | doi:10.17602/M2/M6074 | Ply, mesh file |
| IPS-7801 | Calcaneus | Left | M6355-6075 | doi:10.17602/M2/M6075 | Ply, mesh file |
| IPS-7984 | Calcaneus | Right | M6356-6076 | doi:10.17602/M2/M6076 | Ply, mesh file |
| IPS-7986 | Calcaneus | Left | M6357-6077 | doi:10.17602/M2/M6077 | Ply, mesh file |
| IPS-7987 | Calcaneus | Left | M6358-6078 | doi:10.17602/M2/M6078 | Ply, mesh file |



Master copy is....

- Whatever all derivative copies lead back to

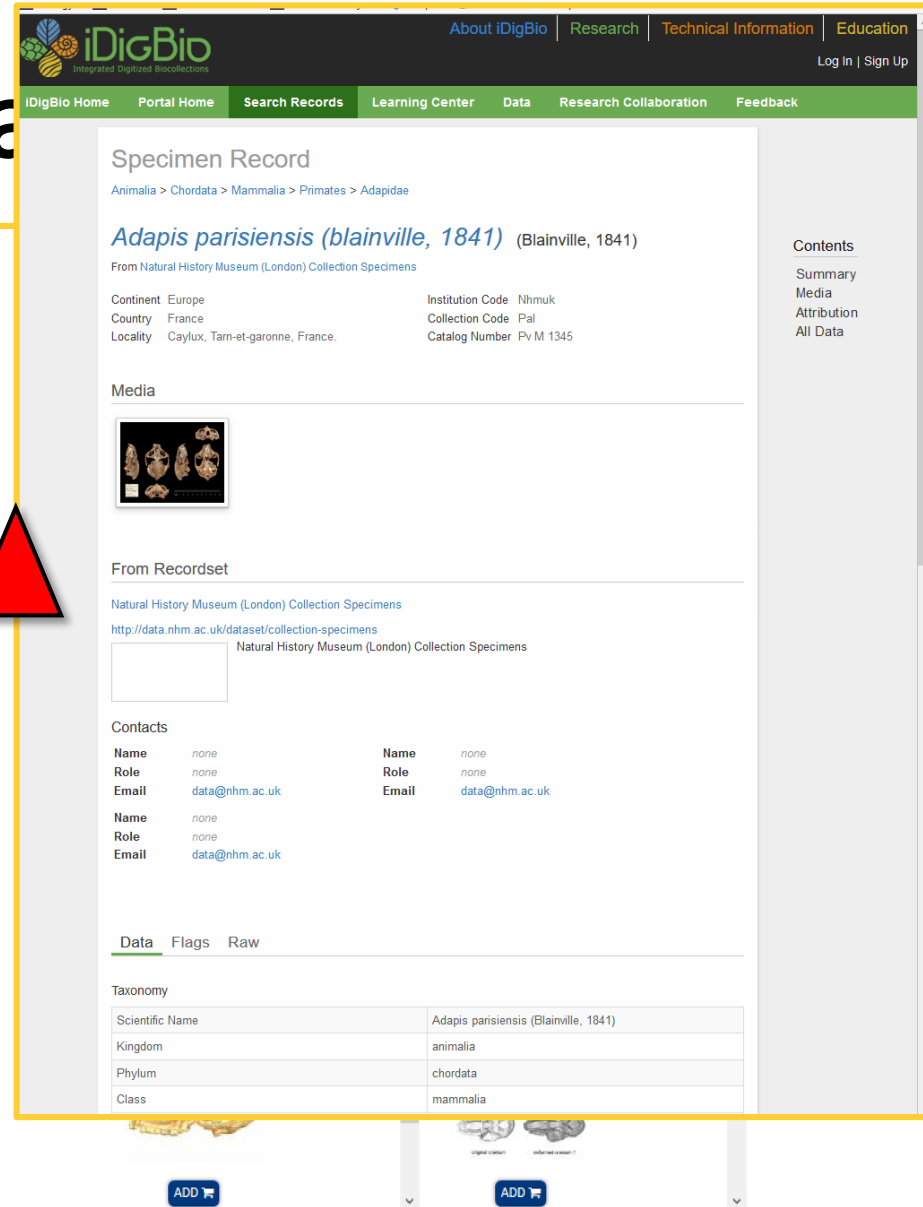


Provenance

MorphoSource *approach* to provenance

Provenance

- Links to museum-verified record



iDigBio Integrated Digitized Biocollections

About iDigBio | Research | Technical Information | Education | Log In | Sign Up

iDigBio Home | Portal Home | Search Records | Learning Center | Data | Research Collaboration | Feedback

Specimen Record

Animalia > Chordata > Mammalia > Primates > Adapidae

***Adapis parisiensis* (blainville, 1841)** (Blainville, 1841)

From Natural History Museum (London) Collection Specimens

| | | | |
|-----------|----------------------------------|------------------|-----------|
| Continent | Europe | Institution Code | Nhmuk |
| Country | France | Collection Code | Pal |
| Locality | Caylux, Tarn-et-garonne, France. | Catalog Number | Pv M 1345 |

Media

From Recordset

Natural History Museum (London) Collection Specimens

<http://data.nhm.ac.uk/dataset/collection-specimens>

Natural History Museum (London) Collection Specimens

Contacts

| | | | |
|--------------|----------------------------------------------------|--------------|----------------------------------------------------|
| Name | none | Name | none |
| Role | none | Role | none |
| Email | data@nhm.ac.uk | Email | data@nhm.ac.uk |

Data | **Flags** | **Raw**

Taxonomy

| | |
|-----------------|----------------------------------------------|
| Scientific Name | <i>Adapis parisiensis</i> (Blainville, 1841) |
| Kingdom | animalia |
| Phylum | chordata |
| Class | mammalia |

Contents

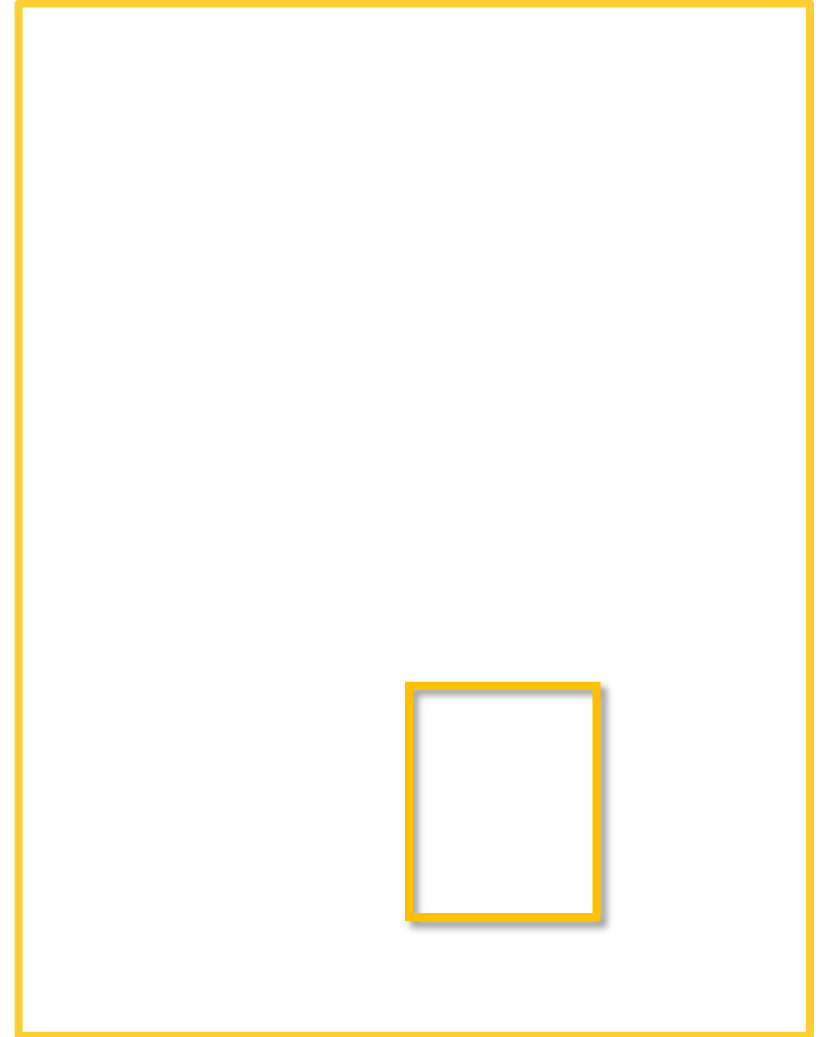
- Summary
- Media
- Attribution
- All Data

Related Specimens

- [12.9.964. Casuarius](#)
- [Phk-1.](#)
- [1.776. Papio hamadryas](#)
- [11.18.25. Presbytis](#)
- [3.1.8. Presbytis femoralis](#)
- [2.8.6. Presbytis femoralis](#)
- [Phk-2.](#)
- [11.18.17. Presbytis](#)
- [Phk-3.](#)
- [10.9.2. Rhinopithecus](#)
- [Phk-4.](#)
- [1345. Adapis parisiensis](#)
- [Phk-5.](#)
- [7945. Archaeolemur cf.](#)
- [1973.66.160. Corvus corax](#)
- [7946. Hadropithecus](#)
- [1981.39.1. Tyto alba](#)
- [7.10.14. Presbytis](#)

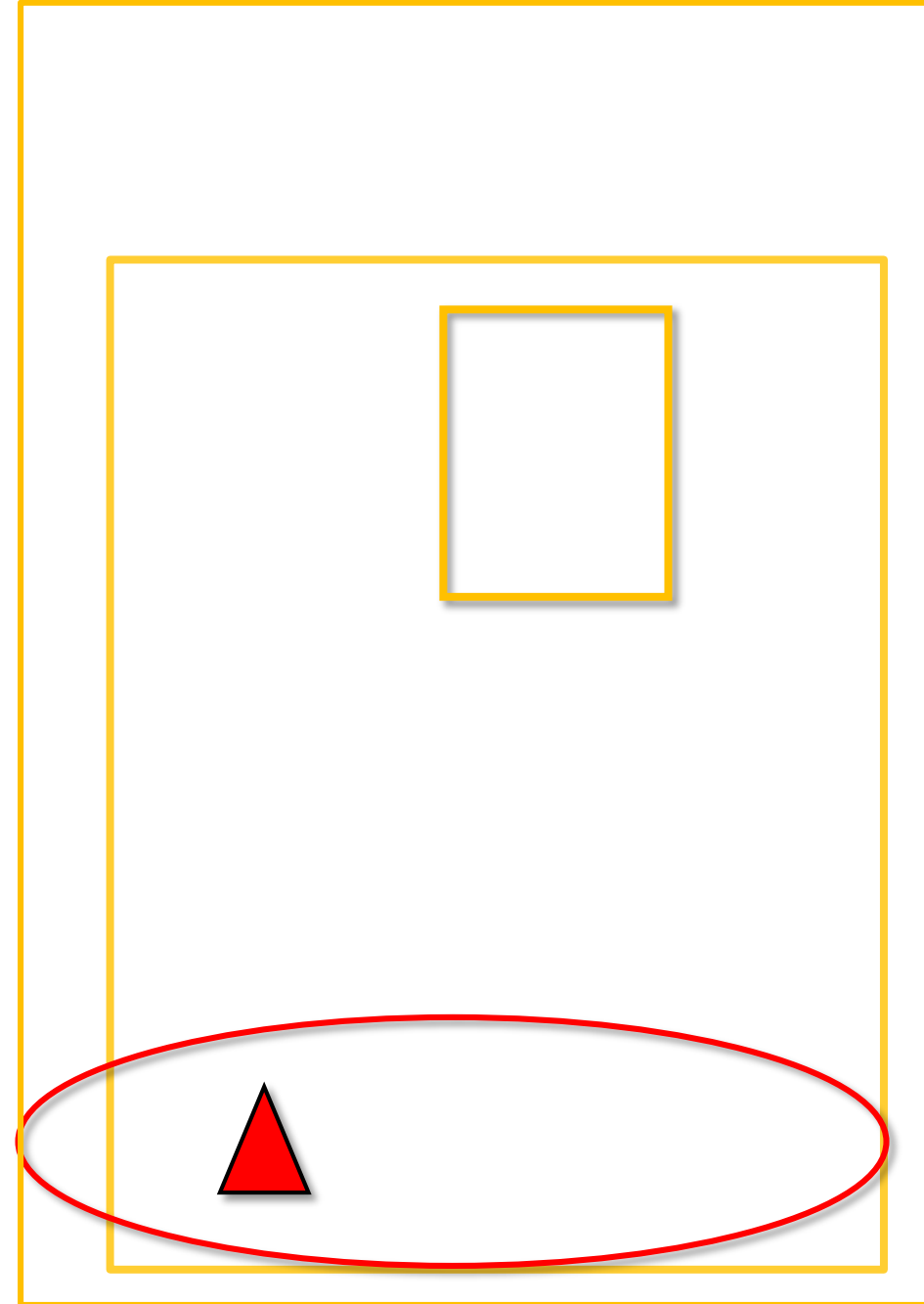
Provenance

- Links to museum-verified record
- All files from a scanning event linked



Provenance

- Links to museum-verified record
- All files from a scanning event linked



MORPHO

SO

Pro

- Lin

- All

lin

M15382-28197, Used for media preview

File info: 3D Mesh (Polygon File Format); 190.63 MB

Title: Smooth Surface Mesh

Description/Element: Cranium

Side: -

File publication status: Not published / Not available in public search

File type: derivative file

Derived From: M15382-28196

Distance units of coordinate system for mesh files: -

Maximum distance in X direction in millimeters between points of mesh coordinates: -

Maximum distance in 3-dimensional space in millimeters between two most distant points on mesh surface: -

Notes: Scanner reverses side

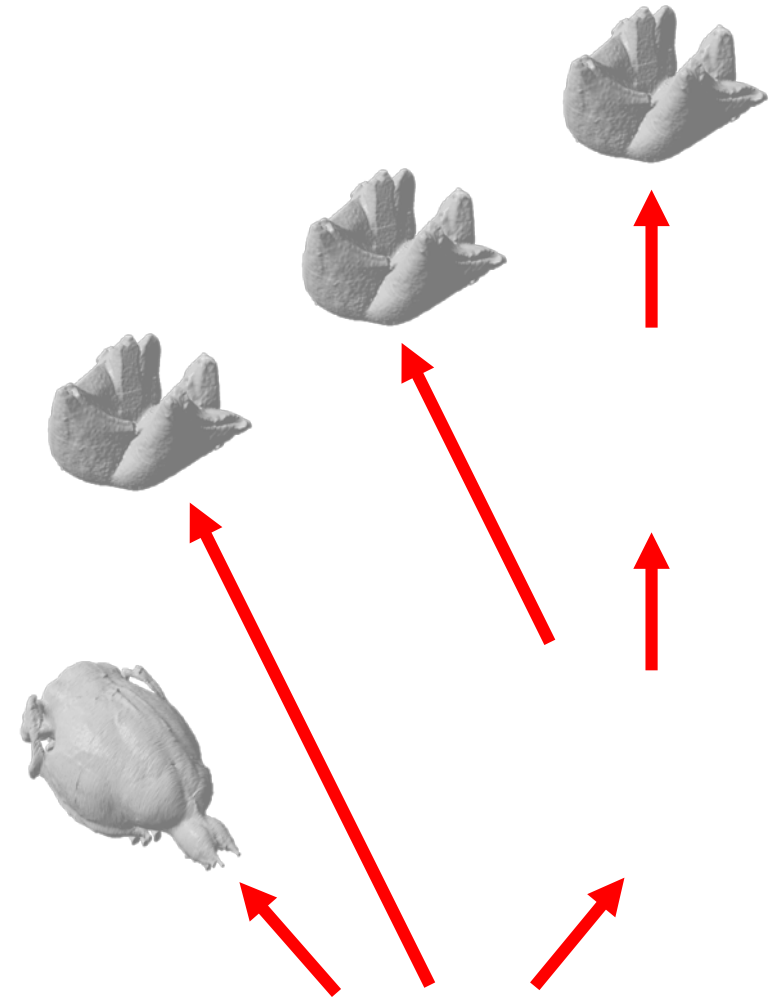
Downloads: 0



MORPHO SOURCE approach

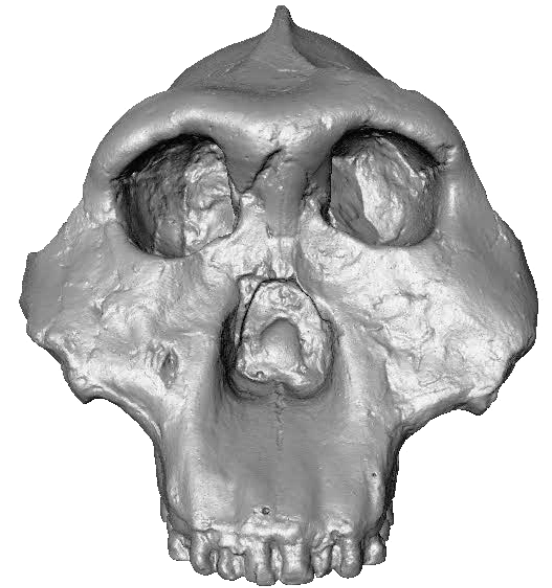
Provenance

- Links to museum-verified record
- All files from a scanning event linked
- Specifying derivation allows genealogy of provenance to be created at any time



Outline

- Critical data
- Digital provenance
- **Managing long term storage**
- Challenges for repositories





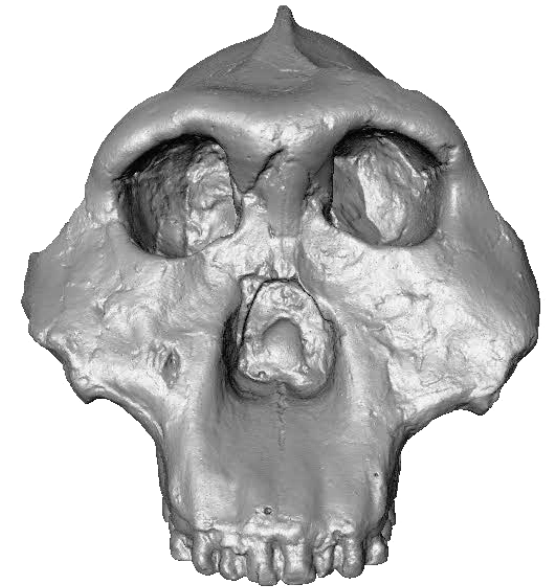
Long term storage

- Endowments (private/commercial contributions)
- Extensible prepayments (non-profit contributions – e.g., Federal grants)
- Cloud or not?
- Careful decisions about what is archived and how it is described
- Community networks & standards-based data models



Outline

- Critical data
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- **Challenges for repositories**

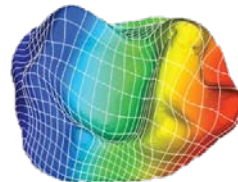
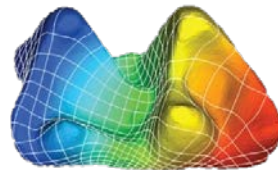
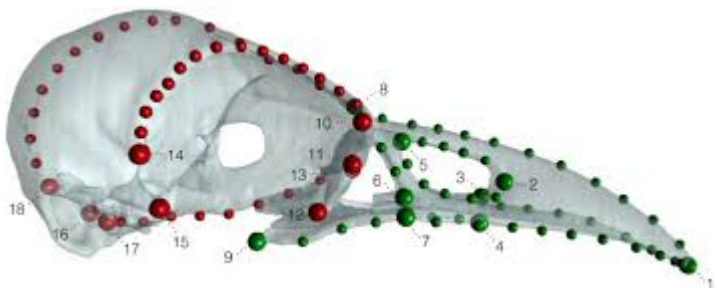




Challenges

Repository data must have or create value

- Education
- Research
- Promote importance of physical collection
- Commercial?





MORPHO SOURCE



approach

SDSC SAN DIEGO
SUPERCOMPUTER CENTER



IGS INDIANA GEOLOGICAL
& WATER SURVEY
INDIANA UNIVERSITY



 Smithsonian



 PennState



Add value

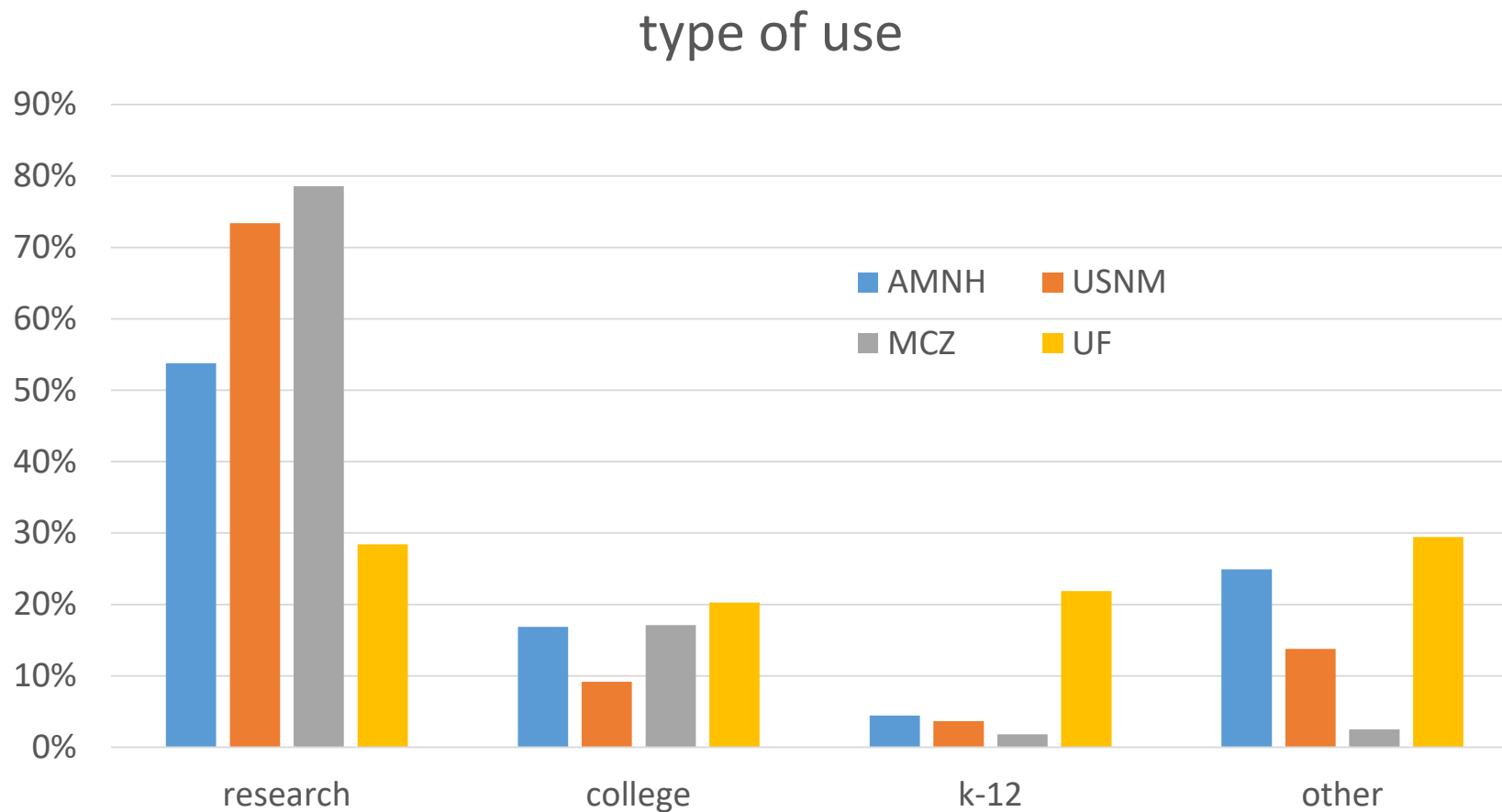
- Track data use for researchers and institutions (*current*)
- Integrate data with analysis platforms (*in review ABI proposals with L. Frank & M. Maga*)
- Connect data with interfaces that promote use in teaching (*current work*)
- Serve data to aggregators to improve discoverability (*current work*)
- Integrate database indexes to increase discoverability and data value (*in review proposal with Duke, IU, and Smithsonian*)

Add Security

- Network storage for a 'cloud-like' platform (planned work by Duke & Penn State)

Tracking datasets on MorphoSource

Comparing Collections





Summary



- The ability to support data archives long term is intertwined with short term data accessibility and discoverability
- Adequate and standardized descriptions of 3D data are a fundamental starting point
- Establishing multiple points of discoverability and integrated accessibility is key
- No single best solution for storage costs has been identified but amplified data value is critical

55 Project Specimens

NEW SPECIMEN

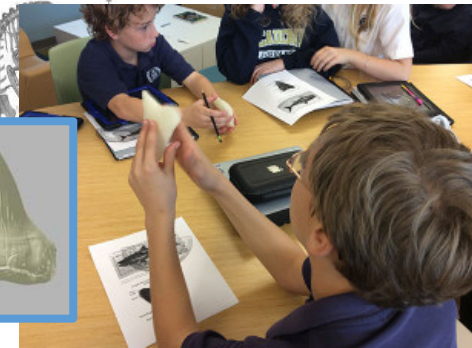
Group by: [Specimen Number](#) | [Genus](#) | [Species](#)



[AMNH-M-174360](#), *Microcebus rufus*
iDigBio



[AMNH-M-183285](#), *Callimico goeldii*
iDigBio



Impact


usage
downloads
views


peer-review
expert opinion


citations


alt-metrics
storage
links
bookmarks
conversations





Acknowledgments



- Jennifer Moore and Adam Rountrey for invitation

For support & funding of MorphoSource Development

- Duke University Trinity College of Arts & Sciences
- National Science Foundation Grants (BCS-1552848, DBI-1661386, DBI-1701714)
- Duke Library
- Duke's office of Research

For discussion leading to development of concepts

- Jukka Jernvall, Alistair Evans, Gudrun Evans, David Blackburn, Edward Stanley, James Thostenson, Jocelyn Sessa, Maureen O'Leary, Mark Uhen, Gabriel Yapuncich
- AMNH, MCZ, UCMP, DPC, Wits

For work developing and populating MorphoSource

- Seth Kaufman, Maria Passarotti (Whirl-i-gig, Inc.)
- Duke Library Digital Repository Staff
- Alex Thompson, Kevin Love, Dan Stoner (iDigBio)
- Many Technicians & students

